As described in the specification at [0012], the liquid forming the boundary layer advantageously is the same liquid coming from the jet. The changes to claim 1 below are intended to clarify the form and location of the two liquid elements, rather than their composition or relative temperatures. The jet is in the form of a liquid column flowing towards the workpiece. The boundary layer in the form of a layer on the workpiece. The word "pressurized" has been removed from claim 13, and the phrase "at least in part" has been removed from claim 25, in order to overcome the specific § 112 rejections of those claims.

With respect to the § 112 rejection of claim 1 stating that the phrase "a heated liquid" is indefinite and very broad because specific temperature has not been recited, Applicants submit that paragraphs [0054] and [0055] of the application provide adequate support for the phrase "a heated liquid". Specifically, paragraph [0054] states that "ozone has a limited solubility in the heated deionized water," and that "the elevated temperature promotes the reaction kinetics." Thus, the elevated temperature refers to the heated liquid.

Paragraph [0055] goes on to state that "elevated or high temperatures mean temperatures above ambient or room temperature, that is temperatures above 20 or 25° and up to about 200°C." Thus, this language provides adequate support for the claimed "heated liquid" language, i.e., that the "heated liquid" refers to a liquid at a temperature above 20 or 25°C, and up to about 200° C.

Turning to the § 103 rejections at paragraphs 13 and 14 of the Office Action, Applicants agree with the Examiner that the primary reference, Matsuoka, does not teach the use of a heated liquid, and that Matsuoka teaches using liquid at 20 and 25° C (see

Example 1, p. 5), as stated at paragraph 13 of the Office Action. As explained above, however, the claimed "heated liquid" language, as supported by the specification, specifically refers to liquid at temperatures above 20 or 25° C, and up to 200° C.

Not only does Matsuoka not teach using a heated liquid at temperatures above 25° C, Matsuoka specifically teaches away from using a heated liquid at all. For example, Matsuoka states:

> "A problem with a dry treatment using ozone is that when resists implanted at high doses are treated at relatively high temperatures, pumping, etc., takes place through heat, making some resist residues likely to remain intact" (p. 2, lines 56-58); and
>
> "Heating the substrates does not permit wet ozone to have well-enough effects, because any thin water film cannot occur even when a wet ozone-containing gas is fed" (p. 3, lines 34-35).

Consequently, Matsuoka teaches away from heating, and there is clearly no suggestion to use a heated liquid at temperatures above 25° C, and up to 200° C. Thus, it is improper to combine the teachings of Matsuoka with a reference that teaches the use of a heated liquid to treat a workpiece (see MPEP § 2145(X)(D)(2), stating, "it is improper to combine references where the references teach away from their combination"). Since all of the claims recite using a heated liquid to form a boundary layer on a workpiece surface, and all of the claims were rejected over Matsuoka, either alone or in combination with other references, Applicants submit that the claims are in condition for allowance.

Additionally, none of the cited references teach directing a liquid jet, or a jet of steam, through a liquid boundary layer to physically dislodge contaminants from a workpiece, as recited in independent claims 1, 25, and 35. Rather, Matsuoka teaches spraying ultra-pure water onto a substrate surface to form a thin liquid film on the substrate surface (p. 5, lines 26-28). Thus, the boundary layer in Matsuoka is formed by spraying ultra-pure water onto the substrate surface. Contaminants are then removed by ozone that is dissolved in the liquid boundary layer.

Additionally, since the ultra-pure water is applied as a spray (pg. 3, lines 16, 26, 41), and not a jet, it cannot dislodge contaminants from a wafer, as claimed. Rather, in Matsuoka, the water is sprayed onto the substrate merely to form the liquid boundary layer. Referring to Figs. 1-3 of Matsuoka, if the water were sprayed at high pressure, it would likely deflect off of the substrate surface, because the spray angle is nearly parallel to the wafer surface.

Moreover, because the ultra-pure water is sprayed onto the substrate to form a liquid boundary layer, it is not directed through the boundary layer, as claimed. Thus, Matsuoka teaches a process that is substantially unrelated to the claimed invention. None of the other cited references teach forming a heated boundary layer on a workpiece surface, or directing a liquid jet through a boundary layer to remove contaminants from the workpiece. Thus, all of the claims are believed to be in condition for allowance.

With respect to claims 3 and 4, none of the cited references teach or suggest pressurizing a liquid jet to a pressure of 100-15,000 psi, or 400-800 psi, as claimed. With respect to claim 5, Matsuoka teaches away from heating a liquid jet to a temperature of 65-

99° C. With respect to claims 28, 29, and 30, Matsuoka teaches away from heating the workpiece, or from heating the workpiece by heating a liquid jet or by introducing steam to the workpiece. With respect to claim 36, Matsuoka teaches away from forming a boundary layer of heated liquid on a workpiece via condensation from steam. With respect to claim 37, Matsuoka teaches away from forming a boundary layer of heated liquid on a workpiece via a liquid jet. With respect to new claims 40 and 41, Matsuoka teaches away from using a heated liquid at a temperature in the range of 55-120° C, or 85-105° C. See the sections from Matsuoka quoted above.

In view of the foregoing, it is submitted that the claims are in condition for allowance, and a Notice of Allowance is requested.

Respectfully submitted,

Perkins Coie LLP

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Kenneth H. Ohriner
Registration No. 31,646

Correspondence Address:

Perkins Coie LLP
Patent – LA
P.O. Box 1208
Seattle, WA 98111-1208
Phone: (310) 788-9900
Fax: (310) 788-3399

REPLACEMENT SPECIFICATION PARAGRAPH

Please amend the title of the invention as follows:

PROCESS ~~AND APPARATUS~~ FOR TREATING A FLAT MEDIA WORKPIECE ~~SUCH AS A SEMICONDUCTOR WAFER~~

COMPLETE SET OF PENDING CLAIMS

1. (Currently Amended) A method for cleaning a flat media workpiece comprising the steps of:

forming a boundary layer of a heated liquid on the workpiece;

providing ozone into the environment around the workpiece; and

directing a liquid jet ~~liquid~~ through the boundary layer to physically dislodge a contaminant on the workpiece.

2. (Currently Amended) The method of claim 1 where the liquid jet comprises water.

3. (Currently Amended) The method of claim 1 where the liquid jet is pressurized to about 100-15,000psi.

4. (Currently Amended) The method of claim 1 where the liquid jet is pressurized to about 400-800psi.

5. (Currently Amended) The method of claim 1 further comprising the step of heating the liquid jet to 65-99 degrees C.

6. (Original) The method of claim 1 where the ozone is provided as a dry gas into the environment around the workpiece.

7. (Currently Amended) The method of claim 1 where the ozone is provided into the environment around the workpiece by introducing ozone into the liquid used to form the liquid jet.

8. (Original) The method of claim 1 further comprising the step of spinning the workpiece to help form the boundary layer

9. (Original) The method of claim 2 where the liquid further comprises a member selected from the group consisting of hydrofluoric acid, hydrochloric acid, ammonium hydroxide, and hydrogen peroxide.

10. (Original) The method of claim 1 where the liquid comprises a member selected from the group consisting of sulfuric acid, phosphoric acid, and halogenated hydrocarbons.

11. (Original) The method of claim 1 further comprising the step of irradiating the workpiece with electromagnetic energy.

12. (Original) The method of claim 11 wherein the electromagnetic energy comprises a member selected from the group consisting of ultraviolet , infrared , microwave, gamma or x-ray radiation.

13. (Currently Amended) The method of claim 1 further comprising the step of moving the ~~jet of pressurized~~ liquid jet relative to the workpiece, so that substantially all areas of the workpiece surface facing the jet are exposed at least momentarily to the jet.

14. (Currently Amended) The method of claim 1 where the liquid jet is perpendicular to the workpiece.

15. (Original) The method of claim 13 further comprising the step of placing the workpiece within a process chamber.

16. (Original) The method of claim 8 where the workpiece is rotated at about 100-2000rpm.

17. (Currently Amended) The method of claim 13 further including the step of moving the liquid jet on a swing arm within the chamber.

18. (Original) The method of claim 1 further comprising the step of introducing sonic energy to the workpiece.

19. (Original) The method of claim 18 where the sonic energy is introduced to the workpiece by a sonic transducer in the chamber and in contact with the workpiece.

20. (Currently Amended) The method of claim 18 where the sonic energy is introduced to the workpiece by introducing sonic energy into a nozzle forming the liquid ~~into the~~ jet.

21. (Currently Amended) The method of claim 1 further comprising the step of cooling the heated liquid to a temperature below ambient, to increase the density of the heated liquid and the energy imparted to the workpiece as the liquid jet ~~of liquid~~ contacts the workpiece.

22. (Currently Amended) The method of claim 1 where the liquid jet has a diameter of from about .5-10 mm.

23. (Currently Amended) The method of claim 1 where the workpiece has a top surface and a bottom surface, and where the liquid jet is directed from below against the bottom surface.

24. (Original) The method of claim 13 where the relative movement occurs at a rate of from about .5 – 500 linear mm per second.

25. (Currently Amended) A method for cleaning a flat workpiece comprising the steps of:

providing heated liquid onto a surface of the workpiece;

spinning the workpiece to~~, at least in part,~~ form the heated liquid into a boundary layer;

moving a high pressure liquid jet ~~of liquid~~ across the surface of the workpiece, with the jet penetrating through the boundary layer and impacting against the surface of the workpiece, to physically remove a contaminant from the surface; and

providing ozone around the workpiece, with the ozone diffusing through the boundary layer.

26. (Original) The method of claim 25 where the ozone is provided by placing the workpiece into a chamber and supplying ozone gas into the chamber.

27. (Currently Amended) The method of claim 25 where the ozone is provided by supplying ozone into the liquid forming the liquid jet.

28. (Original) The method of claim 25 further comprising heating the workpiece.

29. (Currently Amended) The method of claim 28 where the heating is performed by heating the liquid ~~forming the~~ jet.

30. (Original) The method of claim 28 where the heating is performed by introducing steam to the workpiece.

31. (Cancelled)

32. (Cancelled)

33. (Cancelled)

34. (Cancelled)

35. (Original) A method for cleaning a flat media workpiece comprising the steps of:

forming a boundary layer of a heated liquid on the workpiece;

providing ozone into the environment around the workpiece, with the ozone diffusing through the boundary layer; and

directing a jet of steam through the boundary layer to physically dislodge a contaminant on the workpiece.

36. (Original) The method of claim 35 where the boundary layer of heated liquid is formed via condensation of the steam from the jet of steam.

37. (Currently Amended) The method of claim 1 where the boundary layer of heated liquid is formed from the liquid jet ~~of liquid~~.

38. (Cancelled)

39. (Currently Amended) The method of claim 1 wherein the liquid jet is at an oblique angle to the workpiece.

40. (New) The method of claim 1 wherein the heated liquid is at a temperature in the range of 55-120° C.

41. (New) The method of claim 40 wherein the heated liquid is at a temperature in the range of 85-105° C.